A NEW ERA IN GEODESY & CARTOGRAPHY: IMPLICATIONS FOR LANDING SITE OPERATIONS.

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The Mars Global Surveyor (MGS) Mars Orbiter Laser Altimeter (MOLA) global dataset has ushered in a new era for Mars local and global geodesy and cartography. These data include the global digital terrain model (DTM – radii), the global digital elevation model (DEM – elevation with respect to the geoid), and the higher spatial resolution individual MOLA ground tracks.

Currently there are about 500,000,000 MOLA points and this number continues to grow as MOLA continues successful operations in orbit about Mars. The combined processing of radiometric X-band Doppler and ranging tracking of MGS together with millions of MOLA orbital crossover points has produced global geodetic and cartographic control having a spatial (latitude / longitude) accuracy of a few meters and a topographic accuracy of less than 1 meter [1].

This means that the position of an individual MOLA point with respect to the center-of-mass of Mars is know to an absolute accuracy of a few meters. The positional accuracy of this point in inertial space over time is controlled by the spin rate uncertainty of Mars which is less than 1 km over 10 years that will be improved significantly with the next landed mission.

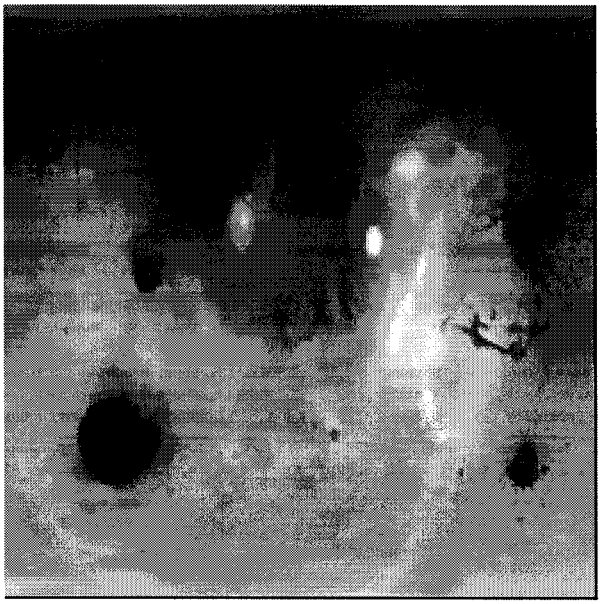
MOLA observed features or areas on Mars are subject to these same levels of inherent accuracy but are limited at a larger uncertainty because of the 160 m MOLA spot size and 300 m spacing between points along track. This spatial sampling or resolution of MOLA degrades the accuracy at the 100 m level when interpolating a feature location because of the limited spatial resolution. Relating these features to earth, as is needed for targeting a lander, becomes additionally corrupted at the few hundred meter level due to Mars ephemeris uncertainties. Continued orbiter and landed missions will reduce this error.

Techniques for registering other dataset to MOLA are becoming more common, allowing the registration and map projection of higher resolution datasets such as Viking Orbiter and MOC NA imaging to the MOLA reference surface and latitude / longitude coordinate grid. These registered higher spatial resolution datasets will share the positional uncertainties due to MOLA spatial resolution and Mars ephemeris uncertainties at the few hundred meter level.

Prior to MGS / MOLA, the positional uncertainties of features relative to the Mars center-of-mass, inertial space and relative to earth were at the 10 km level. The MOLA dataset is now reducing this uncertainty by 2 orders of magnitude, ushering in a new era for Mars geodesy and cartography.

This level of accuracy now reduces the cartographic map error contribution to the MER landing ellipses to a negligible number. Also, the global radii and elevation data will play a major role is downsizing potential landing sites when applying entry engineering constraints.

Such accuracies also support the evolving Entry, Descent and Landing (EDL) technologies by providing absolute inertial ties that could also be used by approach optical navigation for landing targeting



MOLA Global DEM using only 1/5th of the existing dataset

References: [1] Neumann G. A., Rowlands D.D., Lemoine F. G., Smith D. E., and Zuber M. T., submitted to *JGR,* September 11, 2000.

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